MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

SUPPLEMENTARY EXAMINATION

TRIMESTER 1, 2015/2016

BEC2044 –ECONOMETRICS I

(All sections / Groups)

18 NOV 2015
9.00 AM – 11.00 AM
(2 HOURS)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of FOUR pages with FOUR questions only excluding cover page.
2. Attempt **ALL** questions. The distribution of the marks for each question is given.
3. Write all your answers in the answer booklet provided.
4. Formulas and statistical tables are attached.

QUESTION 1

To investigate the rate of growth of population in Belize over the period 1970 – 1992, Mukherjee *et al.* (1998) estimated the following two models:

Dependent variable: log of population in millions (*lnpop*)

Independent variables	Model 1	Model 2
Constant (c)	4.73	4.77
[*t-statistic*]	[781.25]	[2477.92]
Trend/time (t)	0.024	0.015
[*t-statistic*]	[54.71]	[34.01]
Dummy1 (D_1)	-	-0.075
[*t-statistic*]		[-17.03]
Dummy2 (D_2)	-	0.011
[*t-statistic*]		[25.54]
R-squared	0.568	0.639
Jarque-Bera χ^2 statistics	5.69	6.01

Note: Dummy1 represents dummy variable where 1 for observations beginning in the 1978 and 0 before 1978. Dummy2 represents interactive dummy variable where D_1 is multiplied with trend/time (t).

(a) Does the sign of the coefficient of trend/time variable make economic sense? Justify your answer. (3 marks)

(b) In Model 1, what is the rate of growth of Belize's population over the sample period? (3 marks)

(c) Is Dummy1 statistically significant in explaining the population in Model 2? Use 5% as the level of significance. (5 marks)

(d) Is Dummy2 statistically significant in explaining the population in Model 2? Use 5% as the level of significance. (5 marks)

(e) In Model 2, is there a positive relationship between the population and the trend? Use 5% as the level of significance. (6 marks)

(f) Is the error term normally distributed in Model 2? Use 5% as the level of significance. (5 marks)

(g) Based on Model 2, on average, is population growth rate before 1978 higher or lower than population growth rate after 1978? By how much? (5 marks)

(h) Interpret the coefficient of Dummy1. (2 marks)

Continued...

(i) Explain under what circumstances dummy variables are used as independent variables in regression models. (6 marks)

(Total: 40 marks)

QUESTION 2

(a) Briefly explain the consequences of the following econometric problems:

(i) Imperfect multicollinearity (2 marks)

(ii) Autocorrelation (2 marks)

(iii) Heteroscedasticity (2 marks)

(b) Consider the following money supply model in Malaysia

$$M2_t = \beta_0 + \beta_1 GDP_t + \beta_2 CPI_t + \beta_3 INT_t + u_t$$

where $M2$ = money supply (in RM)
GDP = gross domestic product (in RM)
CPI = consumer price index
INT = interest rate (in percentage)
u = error term

The following outputs are obtained from EViews:

Dependent Variable: M2
Method: Ordinary Least Square (OLS)
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP	1.523689	0.056492	26.97193	0.0000
CPI	-2030.989	302.2391	-6.719808	0.0000
INT	26.48578	1376.122	0.019247	0.9848
C	52540.41	13024.88	4.033849	0.0003

R-squared	0.993898	Mean dependent var	145484.6
Adjusted R-squared	0.993326	S.D. dependent var	166864.1
S.E. of regression	13632.18	Akaike info criterion	21.98269
Sum squared resid	5.95E+09	Schwarz criterion	22.15864
Log likelihood	-391.6885	Hannan-Quinn criter.	22.04410
F-statistic	1737.335	Durbin-Watson stat	0.959108
Prob(F-statistic)	0.000000		

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Correlation Matrix:

	M2	GDP	CPI	INT
M2	1.000000	0.991721	0.896999	-0.456038
GDP	0.991721	1.000000	0.939649	-0.421299
CPI	0.896999	0.939649	1.000000	-0.266809
INT	-0.456038	-0.421299	-0.266809	1.000000

(i) From the output, can you detect any econometric problems? Explain. (4 marks)

(ii) Given your answer in b (i), what are the consequential impacts on the properties of the least squares estimators and the estimated standard errors if there is an econometric problem detected in the model? Briefly explain. (5 marks)

(iii) Suggest **TWO (2)** remedies that you may use to solve the problem that arises from the estimation of the above model. Briefly explain. (10 marks)

(Total: 25 marks)

QUESTION 3

(a) Briefly explain the following concept of specification errors and their consequences:

(i) Incorrect functional form (2 marks)

(ii) Omitted variables (2 marks)

(iii) Irrelevant variables (2 marks)

(b) Consider the following double log models (standard error in parentheses):

Model 1:

$$\ln \hat{Y} = -3.96 + \underset{(0.148)}{0.112} \ln X_1 + \underset{(0.130)}{1.938} \ln X_2 + \underset{(0.052)}{0.114} \ln X_3$$

$N = 28$ $\qquad \bar{R}^2 = 0.989$ $\qquad DW = 0.23$

Continued...

Model 2:

$$\ln \hat{Y} = -5.76 + 0.21 \ln X_1 + 2.132 \ln X_2$$
$$(1.46) \qquad (0.076)$$

$N = 28$ $\qquad \overline{R}^2 = 0.977$ $\qquad DW = 1.98$

(i) Using appropriate specification criteria, determine whether X_3 is an irrelevant variable. Explain your reasoning. (5 marks)

(ii) With the aid of diagrams, test autocorrelation in both models using the Durbin-Watson d test at the 5 percent level of significance. (8 marks)

(iii) Suppose you re-estimate the Model 1 using Cochrane-Orcutt method and obtain the following model:

Model 3:

$$\ln \hat{Y} = 7.10 + 0.216 \ln X_1 + 0.274 \ln X_2 - 0.00016 \ln X_3$$
$$(0.134) \qquad (0.428) \qquad (0.054)$$

$N = 28$ $\qquad \overline{R}^2 = 0.99$ $\qquad \hat{\rho} = 0.92$

Is there an autocorrelation problem detected in the model? Will you reconsider your answer to b (i)? Explain. (4 marks)

(Total: 23 marks)

QUESTION 4

Based on the Gauss-Markov Theorem, briefly explain the classical assumptions that must be met in order for OLS estimators to be BLUE. (12 marks)

(Total: 12 marks)

End of Page

Formulas

$$\text{t - statistic} = \frac{\hat{\beta} - \beta}{se(\hat{\beta})}$$

$$\text{F - statistic} = \frac{ESS/(k)}{RSS/(n-k-1)} = \frac{R^2/(k)}{(1-R^2)/(n-k-1)}$$

$$R^2 = \frac{ESS}{TSS}$$

$$\text{Adjusted } R^2 = 1 - (1 - R^2)(\frac{n-1}{n-k-1})$$

Total Sum of Squares (TSS) = Explained Sum of Squares (ESS) + Residual Sum of Squares (RSS)

White's general heteroscedasticity test statistics, $\chi^2_{df=k} = n \times R^2$

$\rho \approx 1 - (d/2)$

Statistical Tables

Appendix 1: t-Table

two tails	**0.2**	**0.1**	**0.05**	**0.02**	**0.01**
One tail	**0.1**	**0.05**	**0.025**	**0.01**	**0.005**
df					
10	1.37	1.81	2.23	2.76	3.17
20	1.33	1.72	2.09	2.53	2.84
30	1.31	1.70	2.04	2.46	2.75
40	1.30	1.68	2.02	2.42	2.70
50	1.30	1.68	2.01	2.40	2.68
60	1.30	1.67	2.00	2.39	2.66
75	1.29	1.67	1.99	2.38	2.64
100	1.29	1.66	1.98	2.36	2.63
120	1.29	1.66	1.98	2.36	2.62

Appendix 2: F-table (α=0.05)

df2\df1	1	2	3	4	5	6	7	8
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10
70	3.98	3.13	2.74	2.50	2.35	2.23	2.14	2.07
80	3.96	3.11	2.72	2.49	2.33	2.21	2.13	2.06
100	3.94	3.09	2.7	2.46	2.31	2.19	2.10	2.03
200	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98
500	3.86	3.01	2.62	2.39	2.23	2.12	2.03	1.96
1000	3.85	3.00	2.61	2.38	2.22	2.11	2.02	1.95

Appendix 3: Chi-square table (α=0.05)

df	$\alpha = 0.05$
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
10	18.31
20	31.41
30	43.77
40	55.76
50	67.51
100	124.34

Appendix 4: Durbin Watson d Table

Critical Values for the Durbin-Watson Statistic (d)

Level of Significance $\alpha = 0.05$

n	$k = 1$		$k = 2$		$k = 3$		$k = 4$		$k = 5$	
	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U
10	0.88	1.32	0.70	1.64	0.53	2.02	0.38	2.41	0.24	2.82
15	1.08	1.36	0.95	1.54	0.82	1.75	0.69	1.97	0.56	2.21
20	1.20	1.41	1.10	1.54	1.00	1.68	0.90	1.83	0.79	1.99
25	1.29	1.41	1.21	1.55	1.12	1.66	1.04	1.77	0.95	1.89
30	1.35	1.49	1.28	1.57	1.21	1.65	1.14	1.74	1.07	1.83
40	1.44	1.54	1.39	1.60	1.34	1.66	1.29	1.72	1.23	1.79
50	1.50	1.59	1.46	1.63	1.42	1.67	1.38	1.72	1.34	1.77
60	1.55	1.62	1.51	1.65	1.48	1.69	1.44	1.73	1.41	1.77
70	1.58	1.64	1.55	1.67	1.52	1.70	1.49	1.74	1.46	1.77
80	1.61	1.66	1.59	1.69	1.56	1.72	1.53	1.74	1.51	1.77
90	1.63	1.68	1.61	1.70	1.59	1.73	1.57	1.75	1.54	1.78
100	1.65	1.69	1.63	1.72	1.61	1.74	1.59	1.76	1.57	1.78
150	1.72	1.75	1.71	1.76	1.69	1.77	1.68	1.79	1.66	1.80
200	1.76	1.78	1.75	1.79	1.74	1.80	1.73	1.81	1.72	1.82

n	$k = 6$		$k = 7$		$k = 8$		$k = 9$		$k = 10$	
	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U
10	–	–	–	–	–	–	–	–	–	–
15	0.45	2.47	0.34	2.73	0.25	2.98	0.18	3.22	0.11	3.44
20	0.69	2.16	0.60	2.34	0.50	2.52	0.42	2.70	0.34	2.89
25	0.87	2.01	0.78	2.14	0.70	2.28	0.62	2.42	0.54	2.56
30	1.00	1.93	0.93	2.03	0.85	2.14	0.78	2.25	0.71	2.36
40	1.18	1.85	1.12	1.92	1.06	2.00	1.01	2.07	0.95	2.15
50	1.29	1.82	1.25	1.88	1.20	1.93	1.16	1.99	1.11	2.04
60	1.37	1.81	1.34	1.85	1.30	1.89	1.26	1.94	1.22	1.98
70	1.43	1.80	1.40	1.84	1.37	1.87	1.34	1.91	1.31	1.95
80	1.48	1.80	1.45	1.83	1.43	1.86	1.40	1.89	1.37	1.93
90	1.52	1.80	1.49	1.83	1.47	1.85	1.45	1.88	1.42	1.91
100	1.55	1.80	1.53	1.83	1.50	1.85	1.48	1.87	1.46	1.90
150	1.65	1.82	1.64	1.83	1.62	1.85	1.60	1.86	1.59	1.88
200	1.71	1.83	1.70	1.84	1.69	1.85	1.68	1.86	1.67	1.87

where n = number of observations and k = number of independent variables, excluding the intercept.